

Current Status of the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A method for carrying out gear shifting in a twin-clutch transmission having at least two transmission input shafts, each of which is coupled via a respective clutch to the an engine, wherein after recognition of a desire to shift, ~~the clutch~~ a first clutch from said respective clutches, assigned to the transmission input shaft that is transmitting the torque, is disengaged up to ~~the a~~ slip limit and ~~the an~~ engine torque (T_{eng}) is driven as a function of ~~the a~~ type of shifting in order to achieve a vehicle acceleration desired by ~~the a~~ driver, wherein a torque (T_{emotor}) of an electric motor is used as an additional torque.

2. (original) The method as described in Claim 1, wherein an additional torque is used to achieve the vehicle acceleration desired by the driver.

3. (Cancelled) The method as described in Claim 2, wherein the torque (T_{emotor}) of an electric motor is used as an additional torque.

4. (original) The method as described in Claim 3 2, wherein, in the driving of the torque (T_{emotor}) of the electric motor, the required vehicle acceleration is determined as a function of specific vehicle and/or transmission variables, so that a target torque of the electric motor is calculated and the calculated target torque of the electric motor is used if the target torque is within predetermined minimum and maximum limit values.

5. (currently amended) The method as described in Claim 3 2, wherein said respective clutches further comprise a second clutch and wherein, when the torque (T_{emotor}) of the electric motor is insufficient, the clutch torque of one of ~~the two clutches~~ said first or second clutches is used to control the vehicle acceleration.

6. (original) The method as described in Claim 1, wherein the type of shifting is determined shortly before the beginning of the shift.

7. (currently amended) The method as described in Claim 6, wherein, when a ~~clutch~~ said first clutch is disengaged and when a ~~slipping or gripping clutch~~ said second clutch is brought into the slipping state by a decrease of the clutch torque of ~~the clutch~~ said first clutch, it being decided at the beginning of the slip phase of ~~the clutch~~ said second clutch whether the drive train is under pulling load or pushing load in which a check is made of when the slip is positive or negative on ~~the clutch~~ said second clutch.

8. (currently amended) The method as described in Claim 7, wherein when there is positive slip on ~~the clutch~~ said first clutch that is transmitting torque, if ~~the engine speed~~ an engine speed (ω_{eng}) is somewhat larger than ~~the speed~~ a speed of the active transmission input shaft ($\omega_{inshaft}$), a pulling load is present, and when there is negative slip, if the engine speed (ω_{eng}) is somewhat smaller than the speed of the active transmission input shaft ($\omega_{inshaft}$), a pushing load is present.

9. (withdrawn) The method as described in Claim 6, wherein when the clutch is gripping a check is made of whether the entered engine torque (T_{eng}) is larger than the dynamic engine torque ($\dot{\omega}_{eng} \cdot J_{eng}$).

10. (withdrawn) The method as described in Claim 9, wherein if the entered engine torque (T_{eng}) is larger than the dynamic engine torque ($\dot{\omega}_{eng} \cdot J_{eng}$) the twin-clutch transmission is in pulling mode, the engine being accelerated if the engaged clutch is disengaged, and if the entered engine torque (T_{eng}) is less than the dynamic engine torque ($\dot{\omega}_{eng} \cdot J_{eng}$), the twin-clutch transmission is in pushing mode.

11. (withdrawn) The method as described in Claim 6, wherein the state is considered in which none of the clutches is in the gripping state.

12. (withdrawn) The method as described in Claim 11, wherein the transmitted clutch torque ($T_{clA/B}^{transferred}$) is determined from the minimum value of the particular clutch torque $T_{clA/B}$ that is set and the slip limit of the particular clutch ($T_{clA/B}^{slip}$).

13. (withdrawn) The method as described in Claim 11, wherein in pulling mode the following formula applies:

$$\text{sign}(\omega_{\text{eng}} - i_A \cdot \omega_{\text{vehicle}}) \cdot i_A \cdot T_{clA}^{\text{transferred}} + \text{sign}(\omega_{\text{eng}} - i_B \cdot \omega_{\text{vehicle}}) \cdot i_B \cdot T_{clB}^{\text{transferred}} \geq 0$$

and in pushing mode the following formula applies:

$$\text{sign}(\omega_{\text{eng}} - i_A \cdot \omega_{\text{vehicle}}) \cdot i_A \cdot T_{clA}^{\text{transferred}} + \text{sign}(\omega_{\text{eng}} - i_B \cdot \omega_{\text{vehicle}}) \cdot i_B \cdot T_{clB}^{\text{transferred}} < 0$$

whereby,

ω_{vehicle} = vehicle speed,

i_A = overall ratio of the gear of the first input shaft,

i_B = overall ratio of the gear of the second input shaft,

$T_{clA}^{\text{transferred}}$ = transmitted clutch torque of the first clutch and

$T_{clB}^{\text{transferred}}$ = transmitted clutch torque of the second clutch.

14. (currently amended) The method as described in Claim 1, wherein the slip limit (T_{clA}^{slip}) of ~~the clutch~~ said first or second clutch is determined according to the following formula:

$$T_{clA}^{\text{slip}} = \left| T_{\text{eng}} - J_{\text{eng}} \frac{T_{\text{eng}} + \frac{T_{\text{vehicle}}}{i_A} - \left| \frac{i_B}{i_A} - 1 \right| \cdot T_{clB}}{J_{\text{eng}} + \frac{J_{\text{vehicle}}}{i_A^2}} - \text{sign}\left(1 - \frac{i_B}{i_A}\right) \cdot T_{clB} \right|.$$

15. (currently amended) The method as described in Claim 14, wherein ~~the external~~ an external vehicle torque (T_{vehicle}) of the vehicle is determined for determination of the slip limit (T_{clA}^{slip}).

16. (currently amended) The method as described in Claim 15, wherein the external vehicle torque (T_{vehicle}) of the vehicle is determined when ~~the clutch~~ said first or second clutch is gripping and slipping according to the following formula:

$$T_{\text{vehicle}} = i_A \cdot \left[\dot{\omega}_{\text{eng}} \left(J_{\text{eng}} + \frac{J_{\text{vehicle}}}{i_A^2} \right) - T_{\text{eng}} + \left| \frac{i_B}{i_A} - 1 \right| \cdot T_{clB} \right].$$

17. (currently amended) The method as described in Claim 15, wherein the external vehicle torque ($T_{vehicle}$) of the vehicle when ~~the clutch~~ said first clutch is just starting to slip and when said first clutch is disengaged is determined according to the following formula:

$$T_{vehicle} = \frac{1}{i_A \cdot J_{eng}} \cdot (J_{vehicle} \cdot T_{eng} - \text{sign}\{\omega_{eng} - i_A \cdot \omega_{vehicle}\} \cdot \{i_A^2 \cdot J_{eng} + J_{vehicle}\} \cdot T_{clA}).$$

18. (currently amended) The method as described in Claim 15, wherein, if neither of ~~the two clutches~~ said first and second clutches is gripping, the external vehicle torque ($T_{vehicle}$) of the vehicle is determined according to the following formula:

$$T_{vehicle} = \dot{\omega}_{vehicle} \cdot J_{vehicle} - \text{sign}(\omega_{eng} - i_A \cdot \omega_{vehicle}) \cdot i_A \cdot T_{clA} - \text{sign}(\omega_{eng} - i_B \cdot \omega_{vehicle}) \cdot i_B \cdot T_{clB}.$$

19. (currently amended) The method as described in Claim 1, wherein, in an upshift in pulling mode or a pulling upshift, the engine torque (T_{eng}) is increased in order to develop a slip reserve and keep the motor speed above the speed of the old transmission input shaft that is assigned to the starting gear, ~~the old clutch~~ said first clutch that is assigned to the starting gear is then disengaged with a constant ramp function and ~~the new clutch~~ said second clutch assigned to the target gear is engaged with the same ramp function, the engine torque (T_{eng}) is reduced to a minimum in order to synchronize the engine speed with the speed of the new transmission input shaft that is assigned to the target gear, and the torque (T_{emotor}) of the electric motor is driven in such a manner that the vehicle acceleration desired by the driver is achieved.

20. (currently amended) The method as described in Claim 1, wherein, in an upshift in pushing mode or a pushing upshift, the engine torque (T_{eng}) is reduced to a minimum in order to synchronize the engine speed with the speed of the new transmission input shaft, the vehicle acceleration is driven with ~~the old clutch~~ said first clutch, ~~the old clutch~~ said first clutch is disengaged with a constant ramp function if the engine speed drops below the speed of the new shaft, ~~the old clutch~~ said first clutch is disengaged with a constant ramp function if the engine speed drops below the speed of the new shaft, ~~the old clutch~~ said first clutch is disengaged with a constant ramp function and ~~the new clutch~~ said second clutch is engaged and the torque (T_{emotor}) of the electric motor is driven in such a manner that the vehicle acceleration desired by the driver is achieved.

21. (currently amended) The method as described in Claim 1, wherein, in a downshift in pulling mode or a pulling downshift, the engine torque (T_{eng}) is increased in order to synchronize the engine speed with the speed of the new transmission input shaft, the vehicle acceleration is driven with ~~the old clutch~~ said first clutch, ~~the old clutch~~ said first clutch is disengaged with a constant ramp function if the engine speed climbs above the speed of the new shaft, ~~the old clutch~~ said first clutch is disengaged with constant ramp function and ~~the new clutch~~ the second clutch is engaged if the engine speed climbs above the speed of the new shaft, and the torque (T_{emotor}) of the electric motor is driven in such a manner that the vehicle acceleration desired by the driver is achieved.

22. (currently amended) The method as described in Claim 1, wherein, in a downshift in pushing mode or a pushing downshift, the engine torque (T_{eng}) is reduced to a minimum in order to develop a slip reserve and keep the engine speed under the speed of the old transmission input shaft, ~~the old clutch~~ said first clutch is disengaged with a constant ramp function and ~~the new clutch~~ said second clutch is engaged with the same ramp function, the engine torque (T_{eng}) is increased in order to synchronize the engine speed with the speed of the new transmission input shaft, and the torque (T_{emotor}) of the electric motor is driven in such a manner that the vehicle acceleration desired by the driver is achieved.